

COMPOSITION AND STRUCTURE OF A WEST TEXAS SALT MARSH

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ABSTRACT

This study describes the distribution of species in a 21.6 ha inland salt marsh, consisting of three plant communities. The marsh community is along Leon Creek in the Diamond Y Spring Preserve in Pecos County near Fort Stockton, in western Texas (31°00.54'N, 102°55.49'W). From driest (highest elevation) to wettest (lowest elevation), the sequence is a *Sporobolus airoides* (alkali sacaton, Poaceae) grassland, a *Distichlis spicata* (saltgrass, Poaceae) grassland, and in the drainage a *Schoenoplectus americanus* (bulrush, Cyperaceae) marsh community. The communities were simple, with a total of 15 species found in the marsh. The mean plant cover in the salt marsh was 59%. The *Sporobolus* grassland covered 26% of the marsh and contained six species including *S. airoides* with $52 \pm 36\%$ cover and *D. spicata* with $13 \pm 21\%$ cover. The four other species were *Helianthus paradoxus* (Pecos or puzzle sunflower, Asteraceae), *Suaeda calceoliformis* (seepweed, Chenopodiaceae), *Limonium limbatum* (sea lavender, Plumbaginaceae), and *Sesuvium verrucosum* (sea purslane, Aizoaceae) (<5% cover each). The *Distichlis* grassland covered 50% of the marsh and contained nine species. *Distichlis spicata* had $50 \pm 33\%$ cover followed by *H. paradoxus* at $25 \pm 25\%$ cover, *S. calceoliformis* at $10 \pm 19\%$ and *S. airoides* at $6 \pm 20\%$. The five other species were *S. texanus* (Texas sporobolus, Poaceae), *Flaveria chlorifolia* (yellow flaveria, Asteraceae), *Juncus mexicanus* (Mexican rush, Juncaceae), *S. americanus* and *L. limbatum* (<2% cover each). In the *Schoenoplectus* community that covered only 2% of the salt marsh, there were 11 species. High cover species included *S. americanus* at $39 \pm 33\%$, *D. spicata* at $22 \pm 34\%$, *H. paradoxus* at $11 \pm 26\%$, and *S. texanus* at $9 \pm 14\%$. Seven other species had cover values of one percent or less including *S. calceoliformis*, *J. mexicanus*, *Samolus cuneatus* (brookweed, Primulaceae), *Spartina pectinata* (prairie cordgrass, Poaceae), *Heliotropium curassavicum* (alkali heliotrope, Boraginaceae), *Agalinis calycina* (Leoncita false foxglove, Scrophulariaceae) and *Eleocharis palustris* (spikerush, Cyperaceae).

Key Words: *Helianthus paradoxus*, inland salt marsh, puzzle sunflower, saltgrass, Texas, wetland.

In the past, saline habitats were reported from many areas of the Chihuahuan Desert Region of western Texas, New Mexico, and northeastern Mexico (Henrickson 1977). Wetland habitats associated with rivers, streams, and springs throughout this part of North America, including western Texas, have almost completely disappeared because of anthropogenic lowering of the water table (Brune 1981; Poole 1992; Poole and Diamond 1993; Horne and Kahn 1997). One of the few remaining wetland systems, an inland salt marsh, is associated with the desert springs found along Leon Creek in the Diamond Y Spring Preserve in Pecos County near Fort Stockton, Texas (Veni 1991; Boghici 1997).

Inland salt marshes are located in continental rather than coastal regions (MacNae 1968; Chapman 1974, 1977; Niering and Warren 1980; Haines and Dunn 1985; Odum 1988). They differ from coastal salt marshes because there are no tidal effects, but they are subject to high variation in soil-salt concentrations and time of desiccation, because of high annual variability of precipitation (Borchert 1971; Ungar 1974). Salt concentrations can range from <1% to >25%, composed variously of Na, K, Mg, or Ca cations and Cl, CO₃ or SO₄ anions (Flowers and Evans 1966; Ungar 1970; Burchill and Kenkel 1991; Venie 1991).

Community composition and structure as well as the various salt gradients of many of the inland salt marshes of other parts of North America have been reported (Billings 1945; Chapman 1974; Henrickson 1977; Flowers and Evans 1966; Ungar et al. 1969; Ungar 1970; Burchill and Kenkel

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FIG. 1. Location of the Diamond Y Spring Preserve, Pecos County, Texas.

1991). Vegetational zonation, described for marine salt marshes (Chapman 1977; Niering and Warren 1980; Bertness 1991a) is present in various inland salt marshes, with the most salt tolerant species located in the lowest part of the marsh (Chapman 1974; Burchill and Kenkel 1991). This zonation is probably paralleled by one or more environmental gradients (Bertness 1991a; Bertness and Hacker 1994), and may be modified by herbivory and competition (Reinold et al. 1975; Smith and Odum 1981; Bertness 1991a, b; Furbish and Albano 1994). The gradients, communities and species distributions seem to be more complicated in inland salt marshes because of the arid nature of the uplands in many areas, which is not the case in most coastal marshlands (Chapman 1974; Burchill and Kenkel 1991).

The salt marsh found in the Diamond Y Spring Preserve is ecologically important because it is one of few remaining wetland spring communities in western Texas. In addition, it is the location of one of two Texas populations of the federally threatened sunflower, *Helianthus paradoxus* (the Pecos or puzzle sunflower, Asteraceae, Correll and Johnston 1979; McDonald 1999). It is the only recently reported location of a rare Scrophulariaceae, *Agalinis calycina* (Leoncita false foxglove) (Carr 2001; NatureServe Explorer 2006). Additionally, it is the habitat for two federally listed endangered fish, *Cyprinodon bovinus* (Leon Springs Pupfish) and *Gambusia nobilis* (Pecos Gambusia) and three rare snail species (McDonald 1999). However, there is still little information available concerning the plant community types, species composition, and abiotic and biotic gradients present in the wetlands currently existing in western Texas including the Diamond Y Spring Preserve. Population cover, density, and

fluctuations of most of the species present in this marsh system have not been established.

The locations of the three major plant communities found in the Diamond Y Springs Preserve have been identified in a previous study (Van Auker and Bush 1998). In addition, some of the soil gradients in this system have been demonstrated including the increase in soil depth, soil water content, and salinity as one proceeds from the upland into the marsh (Grunstra 2002; Grunstra and Van Auker 2007). Soil oxygen content decreases as the soil becomes saturated and seems to be very important for the distribution of some of the species (Bush 2006). Although the minor species present have been identified, their cover, location, and community associations in the marsh have never been determined.

Consequently, the objectives of this study were to identify the minority plant species present and delineate their distributions in the salt marsh along Leon Creek in the Diamond Y Spring Preserve. The three major plant communities were reexamined to help determine population cover and distribution fluctuations from the previous work as well as investigate the associations between the minor plant species and the major plant species and communities located in this salt marsh system.

MATERIALS AND METHODS

Field surveys were conducted in October 1998 in the Diamond Y Spring Preserve of the Nature Conservancy of Texas. The Preserve, consisting of 607 ha of upland and salt marsh communities, is located approximately 13 km north of Fort Stockton, Texas (Pecos County, 31°00.54'N, 102°55.49'W). The site is located on Leon Creek, which flows from Leon Spring and drains into the Pecos River (Fig. 1). The salt marsh has been

grazed and exposed to fires in the past but not in recent years. Soils in the Leon Creek drainage are alluvial, gray-black clays of the Balmorhea Association (Jaco 1980; Rives 1980). Elevation increases slowly away from the drainage, but the soils change dramatically. Orla Association soils are fairly level, somewhat saline, pale-brown loams just upslope from the drainage. Further upland, soils are of the Lozier Association and are light brown to gray, very shallow, gravelly, stony soils on limestone hills (Jaco 1980; Rives 1980).

Species were identified according to descriptions found in Correll and Johnston (1979) and Hatch et al. (1990) with nomenclature updated according to NRCS (2006). The physical location and distribution of all species including species cover or density were estimated in quadrats. The quadrats were located along fourteen permanently marked transects established during a previous vegetation study in the salt marsh (Van Auken and Bush 1998). The transects are located 50 m apart and perpendicular to the drainage from the edge of the *P. glandulosa* savanna on the north to the edge of this same community on the south side of the salt marsh. Transects range in length from approximately 250 to 480 m, depending on the distance across the marsh, and included 50–96 quadrats at 5-m intervals along each transect ($n = 1344$). Plant cover of all species encountered was visually estimated in 0.1-m quadrat (20×50 cm) (Brower and Zar 1977). In addition, all *H. paradoxus* plants in each quadrat were counted in order to obtain the density (Van Auken et al. 2005); this count was done because very large changes in cover of *H. paradoxus* occur from early to late in the growing season because it is a broad-leaved annual.

A grid corresponding to transect sample points was created with AutoCAD® (Autodesk, Inc. San Rafael, CA). Using the Geographic Information System ArcGIS 8.1® and its Geostatistical Analyst extension (ESRI, Redlands, CA), this grid was interpolated into a raster surface plot. Both deterministic and geostatistical interpolation methods were compared using the generated cross-validation error statistics for proper surface interpolation (Johnson et al. 2001). Deterministic methods evaluated were: inverse distance weighted, local polynomial, global polynomial, and radial-based function; geostatistical methods evaluated were: ordinary kriging, simple kriging, and universal kriging. Ordinary kriging was found to give the best predictive surface for the data series and was used for all of the plots presented here. The search radius for the interpolation method was divided into four equal segments with a zero angle of incidence. In each segment, cover or density measurements of five data points were averaged. Contour plots were then prepared for

each species using cover or density. Five classes were chosen using smart quantiles (Johnson et al. 2001), which were then approximated in order to encompass all of the generated maps. The five classes were zero, 1–5, 6–15, 16–40, and 41–100.

A generalized map was prepared consisting of the three major communities previously found in the salt marsh (Van Auken and Bush 1998). The three communities were a *Sporobolus airoides* grassland, a *Distichlis spicata* grassland, and a *Schoenoplectus americanus* bulrush marsh. Community limits for the *S. airoides* grassland and the *D. spicata* grassland were established by extrapolation to points on the map where their cover was 25%. Community limits for the *S. americanus* bulrush community were set at 20% cover. These cover values were selected to minimize mapped overlap between communities and areas that could not be classified. Total area of this map and the individual species maps is 21.6 ha.

RESULTS

The apparent exclusiveness of the main perennial species found in the previous study in this west Texas salt marsh was also evident in the current study. For example, along a representative transect, Fig. 2 shows the cover and distribution of two of the most abundant species, *Sporobolus airoides* (alkali sacaton, Poaceae) and *D. spicata* (saltgrass, Poaceae) which were almost mutually exclusive. *Sporobolus airoides* was mainly along the first part of this transect (northwest corner of the study area). It was not present in the center of the transect and then it occurred again (but less consistently) along the last part of the transect (south side of the marsh, Fig. 2). In both parts of this transect, it was found along the edge of the salt marsh, in areas with higher elevation (O. W. Van Auken, personal observation). *Distichlis spicata*, for the most part, had low cover in the first 175 m of this transect (north, Fig. 2), then increased to 30–100% in the next 200 m of this transect and was more sporadic in the last part of the transect (south).

The distributions of the three major communities at the Diamond Y Spring Preserve salt marsh are presented in Fig. 3. The *S. airoides* community was found in the parts of the salt marsh that were slightly higher in elevation (O. W. Van Auken, personal observation) and occupied 5.5 ha (26% of the marsh area) (Fig. 3). These areas were mainly in the northwest part of salt marsh and along the southern edge of the marsh. In the lowest part of the salt marsh along the drainage of Leon Creek, in soils that are saturated for at least part of the year, we found the *S. americanus* community, which occupied 0.4 ha (2% of the marsh area) and

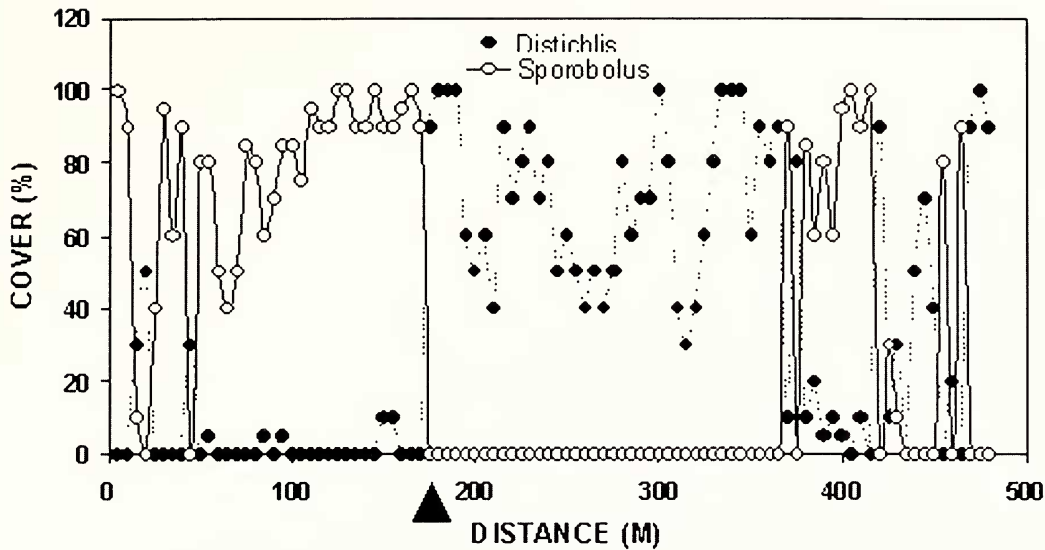


FIG. 2. *Sporobolus airoides* and *Distichlis spicata* cover along a representative transect. This transect extends from the *Prosopis glandulosa* upland vegetation north of the salt marsh (zero) to the creek edge (drainage, lowest part of the marsh), and then to the *P. glandulosa* upland vegetation to the south (500). Each quadrat was 5 m apart. The black triangle below the x axis indicates the location of Leon Creek.

was somewhat disconnected (Fig. 3). Between these two communities at intermediate elevations and apparently intermediate levels of soil water saturation is the *Distichlis* community, with the perennial *D. spicata* as the dominant species. This community was extensive in the salt marsh occupying 10.8 ha (50% of the marsh area) (Fig. 3). Overlap between the *Distichlis* and the

Sporobolus grassland community was 1.4 ha or 6.5% of the total area studied (Fig. 3). Overlap between the *Distichlis* and the *Schoenoplectus* community was 1.0 ha or 4.5% of the area studied. Areas that could not be classified or placed in one of the three community types amounted to 2.4 ha or 11.1% of the total marsh area.

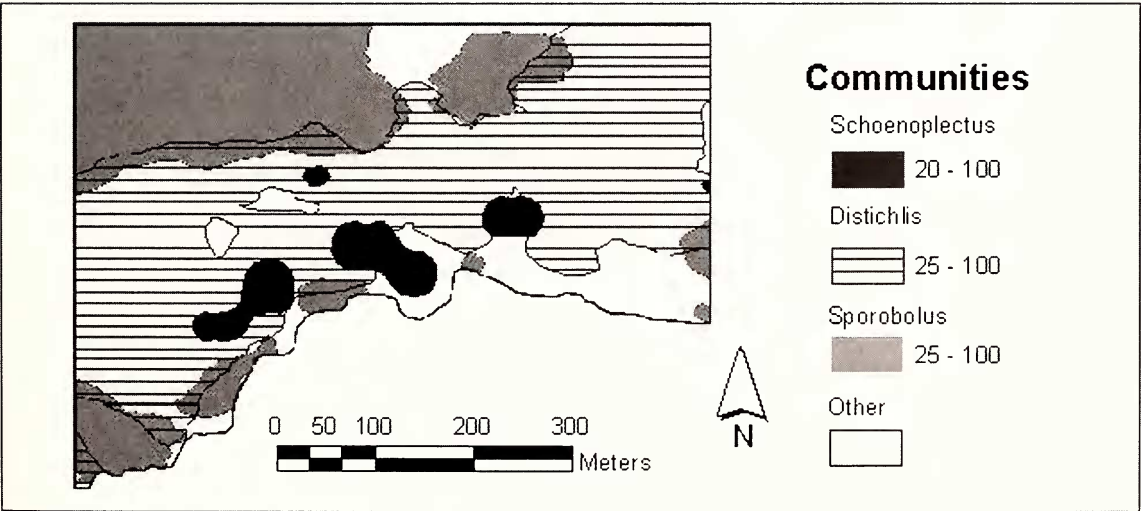


FIG. 3. Distribution of the three plant communities identified along the Leon Creek drainage in the Diamond Y Spring Preserve near Fort Stockton, Texas. The communities are: *Schoenoplectus* = *Schoenoplectus americanus* cover 20–100%, in the wettest part of the marsh; *Distichlis* = *Distichlis spicata* cover 25–100%; and, *Sporobolus* = *Sporobolus airoides* 25–100%, in the highest, driest part of the salt marsh. The dashed line is the Leon Creek drainage. The straight line running north-south in each figure is a dirt road that crosses the salt marsh.

TABLE 1. COVER (%) ± ONE STANDARD DEVIATION FOR EACH SPECIES FOUND IN 0.1-m QUADRATS (N = 1344) IN THE SALT MARSH OF THE DIAMOND Y SPRING PRESERVE NEAR FORT STOCKTON, TEXAS. In addition, the mean cover ± one standard deviation of each species found in each of the three communities identified in the salt marsh is presented. Density (plants m⁻²) is also presented for *H. paradoxus*. A zero in a column indicates that species was not found in that community. *<1% cover **Density, plants/m²

Species	Community Types			
	Marsh total	<i>Sporobolus</i>	<i>Distichlis</i>	<i>Schoenoplectus</i>
<i>Distichlis spicata</i> (Poaceae)	24 ± 32	13 ± 21	50 ± 33	22 ± 34
<i>Sporobolus airoides</i> (Poaceae)	16 ± 31	52 ± 36	6 ± 20	0
<i>Suaeda calceoliformis</i> (Chenopodiaceae)	5 ± 14	2 ± 8	10 ± 19	1 ± 3
<i>Schoenoplectus americanus</i> (Cyperaceae)	2 ± 11	0	3 ± 12	39 ± 33
<i>Limonium limbatum</i> (Plumbaginaceae)	1 ± 3	2 ± 5	1 ± 3	0
<i>Sporobolus texanus</i> (Poaceae)	1 ± 6	0	2 ± 10	9 ± 14
<i>Flaveria chlorifolia</i> (Asteraceae)	1 ± 7	0	—*	0
<i>Juncus mexicanus</i> (Juncaceae)	—*	0	—*	—*
<i>Spartina pectinata</i> (Poaceae)	—*	0	0	—*
<i>Samolus cuneatus</i> (Primulaceae)	—*	0	0	—*
<i>Sesuvium verrucosum</i> (Aizoaceae)	—*	—*	0	0
<i>Heliotropium curassavicum</i> (Boraginaceae)	—*	0	0	—*
<i>Agalinis calycina</i> (Scrophulariaceae)	—*	0	0	—*
<i>Eleocharis palustris</i> (Cyperaceae)	—*	0	0	—*
<i>Helianthus paradoxus</i> (Asteraceae)	9 ± 26	4 ± 22	25 ± 25	11 ± 26
<i>Helianthus paradoxus</i> (Asteraceae)	25 ± 71**	2 ± 17**	44 ± 88**	8 ± 22**
Total cover	59	71	97	82

There were 15 species of herbaceous plants in the salt marsh at the Diamond Y Spring Preserve but no woody species (Table 1). *Distichlis spicata* had the greatest mean cover averaged over the whole area of the salt marsh sampled at 24 ± 32% (±SD), followed by *S. airoides* at 16 ± 31% cover (Table 1). *Helianthus paradoxus* cover was 9 ± 26% with a density of 25 ± 71 plants m⁻² over the salt marsh. Twelve other species had cover values <10%. In the *Sporobolus* community, *S. airoides* cover was 52 ± 36%. Five other species were found in the *Sporobolus* community (Table 1). In the *Distichlis* community, *D. spicata* cover was 50 ± 33% followed by *H. paradoxus* at 25 ± 25% cover and *Suaeda calceoliformis* (see-weed, Chenopodiaceae) at 10 ± 19% cover. Six other species were found in this community with lower cover values (Table 1). The highest mean cover and density of *H. paradoxus* was in the *Distichlis* community at 25 ± 25% and 44 ± 88 plants m⁻² respectively. In the *Schoenoplectus* community, *Schoenoplectus americanus* (bul-rush, Cyperaceae) cover was 39 ± 33%. *Distichlis spicata* and *Sporobolus texanus* (Texas sporobolus, Poaceae), two morphologically similar grasses, had cover values of 22 ± 34% and 9 ± 14% respectively in this community. Eight other species were in this community, for a total of 11 species, making it the community richest in number of species. Variance in cover was high for all species. Standard deviations were approximately half to eight times the mean cover for all species (Table 1).

Spatial patterns of the five species with overall cover values of 1–9% are displayed in Fig. 4.

Limonium limbatum (sea lavender, Plumbaginaceae) was primarily at slightly higher elevation and associated with the *Sporobolus* community. It was sporadic in the *Distichlis* community, usually in the upper part of this community and decreasing in cover toward the drainage (Fig 4a). This distribution is essentially in the northwestern and southwestern edges of the marsh, somewhat elevated from the drainage and close to the *P. glandulosa* upland community (upland community not shown). *Limonium limbatum* was found on approximately 5.8 ha (26.9%) of the marsh surface with the majority (5.3 ha) having cover values of 1–5% and only 0.5 ha with slightly higher cover values of 6–15% (Table 2).

Suaeda calceoliformis was fairly widespread in the marsh found on approximately 15 ha (69.4%) (Table 2), with most quadrats having cover values in the range of 1–40%. The largest portion of this area (6.3 ha) was at cover values of 1–5%. Higher cover values (6–15%, 16–40%) were found on 4.9 ha and 3.7 ha respectively. *Suaeda calceoliformis* had cover values >40% but only in small areas (0.1 ha) (Table 2). However, *S. calceoliformis* was also encountered in parts of the higher elevation grasslands, where *S. airoides* cover was high (Fig. 4b). *Suaeda* had 1–40% cover in approximately half of the area of the salt marsh sampled with greater cover in wetter parts of the *Distichlis* community.

Sporobolus texanus was only present along the drainage and was associated with standing water in the *Schoenoplectus* community in the wettest part of the marsh. It was never detected with *S.*

airoides in the higher elevation, drier grasslands of the salt marsh (Fig. 4c). *Sporobolus texanus* covered approximately 3 ha (13.9%) of the marsh (Table 2). This area was split between the two lower cover classes. *Sporobolus texanus* did have high cover values, but in small areas (Table 2).

Flaveria chlorifolia (yellow flaveria, Asteraceae), was not usually associated with *S. airoides*, in the drier grasslands of the salt marsh (Fig. 4d). It was only in the wettest part of the salt marsh, which had wet soil year-round (O. W. Van Auken personal observation). It was usually associated with *S. texana* or *S. americanus*, but sometimes it occurred with *D. spicata* and *H. paradoxus*. It was only in the southeastern corner of the salt marsh and covered an area of 2.5 ha (11.6%) (Table 2). *Flaveria chlorifolia* was fairly equally spread over the three first cover classes. *Flaveria chlorifolia* had covers values >40% although this was in <0.1 ha of the marsh (Table 2).

Helianthus paradoxus was detected with densities ≥ 6 plants m^{-2} on more than 20% of the salt marsh sampled, mostly in the *Distichlis* community (Fig. 4e). It was usually not in the *Sporobolus* community or in the *Schoenoplectus* community (which is the wettest part of the salt marsh); thus, *H. paradoxus* was not distributed uniformly across the salt marsh. There were large areas in the *Distichlis* community with few or no *H. paradoxus* and other parts of this community that had high densities. Actually, 36.6% of the quadrats from the *Distichlis* community had some *H. paradoxus* plants and covered approximately 13 ha (60.2%) (Table 2). The majority (7.9 ha) of this area had 1–5 plants m^{-2} . Four and a half hectares had 6–15 plants m^{-2} and 0.6 ha had 16–40 plants m^{-2} . There were no areas with *H. paradoxus* densities >40 plants m^{-2} (Table 2).

DISCUSSION

For the most part, community composition, and abiotic and biotic gradients in the inland salt marshes of western Texas and northern Mexico have been largely ignored. Zonation does appear in the Diamond Y Spring Preserve salt marsh as one descends from the slightly higher elevation around the edge of the salt marsh into the center (Fig. 3). The low-density species present in the Diamond Y Spring Preserve salt marsh are found mainly in one community associated with one of the dominant species. However, overall there are very few species present in this salt marsh system.

The reason for the low number of species reported from these salt marsh communities is unknown. Some species that are present in the Diamond Y Spring Preserve could have been

missed in the past because of low cover, low density, cryptic nature, seasonality or a clumped population distribution. A low number of species has been reported previously for saline habitats in western Texas and northern Mexico (Hendrickson 1977; Pinkava 1977). The relatively high levels of Na_2SO_4 in the soil of the Diamond Y Spring Preserve (10 to 40 ppt) and the shallow water table (Grunstra 2002) may play a role. These two factors coupled to high cover of *S. airoides* and high total biomass could prevent entry of other species into the *Sporobolus* community. The *Distichlis* community also has few species, but almost twice as many as the *Sporobolus* community. The cover of the *Distichlis* community may be higher than the *Sporobolus* community (Table 2), but the biomass appears to be lower (O. W. Van Auken, personal observation). *Distichlis spicata* is not a perennial bunchgrass, but a perennial sod forming C_4 grass, and it is lower in stature. In addition, more biomass may be removed from this community by large ungulates, but this is undocumented.

Most of the species reported from the salt marsh are not found in the upland *Larrea tridentata* or *Prosopis glandulosa* communities. These upland areas have low levels of salt, but are also probably too dry most of the year for the growth of the salt marsh species. In the lowest part of the salt marsh, the concentration of organic material in the soil, low soil oxygen, or possibly the redox potential of the soil does not seem suitable for growth of some salt marsh species (Bush 2006) or upland species as has been reported for other salt marsh communities (Webb and Mendelssohn 1996).

The largest number of species (eleven) was found in the *Schoenoplectus* community. This community was only present in the drainage or around the springs, in the wettest part of the salt marsh (Fig. 3). The most common species associated with *S. americanus* were *D. spicata* and *S. texanus*. They were usually encountered around the edge of the *Schoenoplectus* community. *Flaveria chlorifolia* had high cover in some of the wettest areas of the salt marsh and it was associated with *S. americanus*, *D. spicata* and *S. texanus*. All of the other species found in this community seemed to occur in ungulate created disturbances around a spring or seep in the wettest part of the marsh. These species have been reported from saline habitats in other parts of western Texas and northern Mexico but not from other non-saline habitats (Henrickson 1977; Pinkava 1977).

The distributions of the primary perennial grass species were not seen to vary in location from the previous study to the current study. On the other hand the distribution of *Helianthus paradoxus* and some of the other minor species shifted greatly in locations. This could be due to

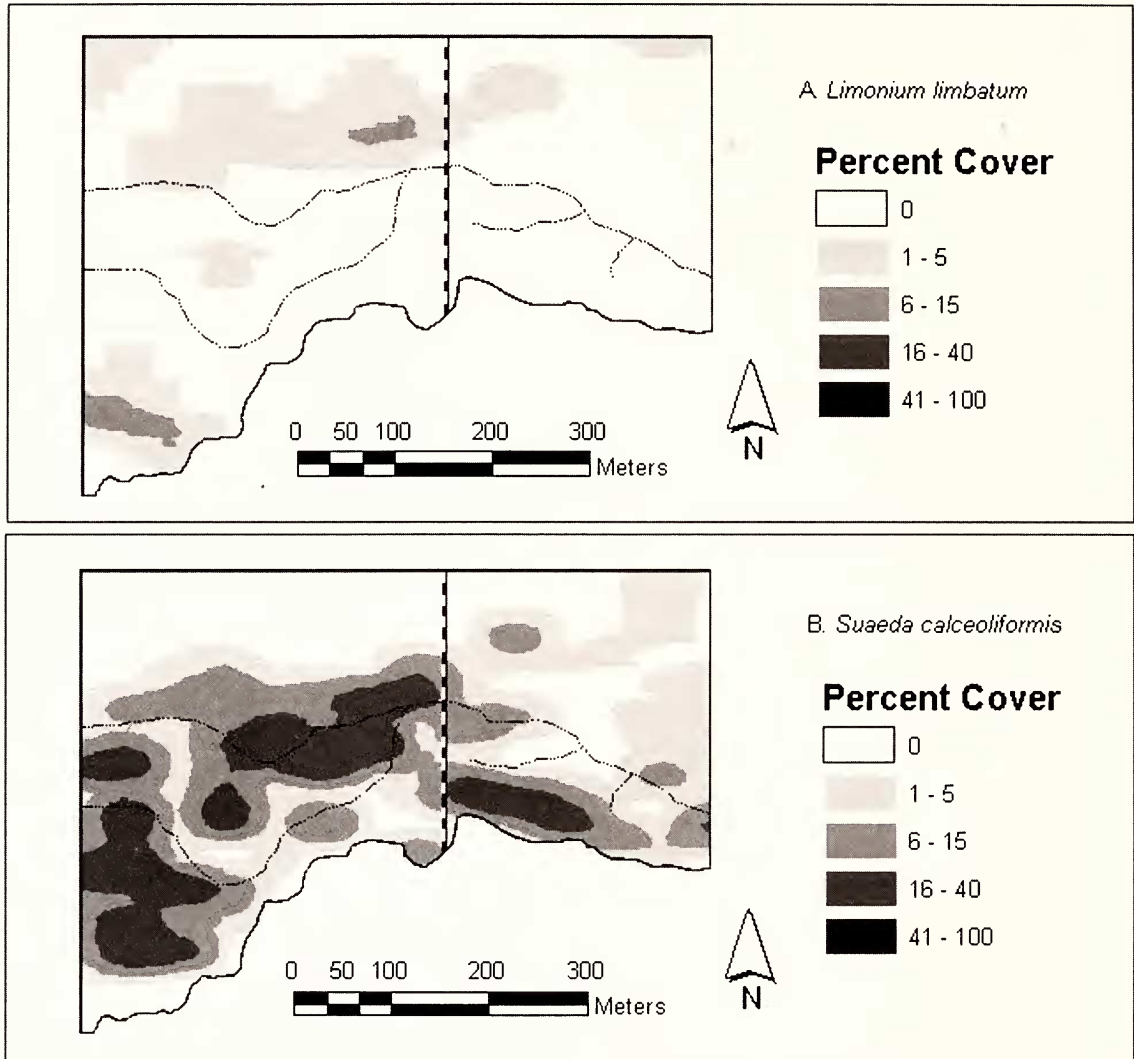


FIG. 4. Distribution of five species in the salt marsh along the Leon Creek drainage in the Diamond Y Spring Preserve near Fort Stockton, Texas. The figure includes: (A) *Limonium limbatum* (sea lavender) percent cover, (B) *Suaeda calceoliformis* (seepweed) percent cover, (C) *Sporobolus texanus* (Texas sporobolus) percent cover, (D) *Flaveria chlorifolia* (yellow flaveria) percent cover, and (E) *Helianthus paradoxus* (Pecos or puzzle sunflower) density. The dashed line is the Leon Creek drainage. The straight line running north-south in each figure is a dirt road that crosses the salt marsh.

a variety of reasons. As annuals, these species could establish in ephemeral gaps produced by grazing, fire, or other disturbance (Bush and Van Auken 1997). Also, temporal and spatial variations in the water level, soil pH, and soil salinity could account for the movement of their distributions (Bush and Van Auken 2004). The specific levels of these abiotic factors during the germination and growth periods of these annuals may influence their individual competitive ability and survivability in the three primary perennial communities (Van Auken and Bush 2006).

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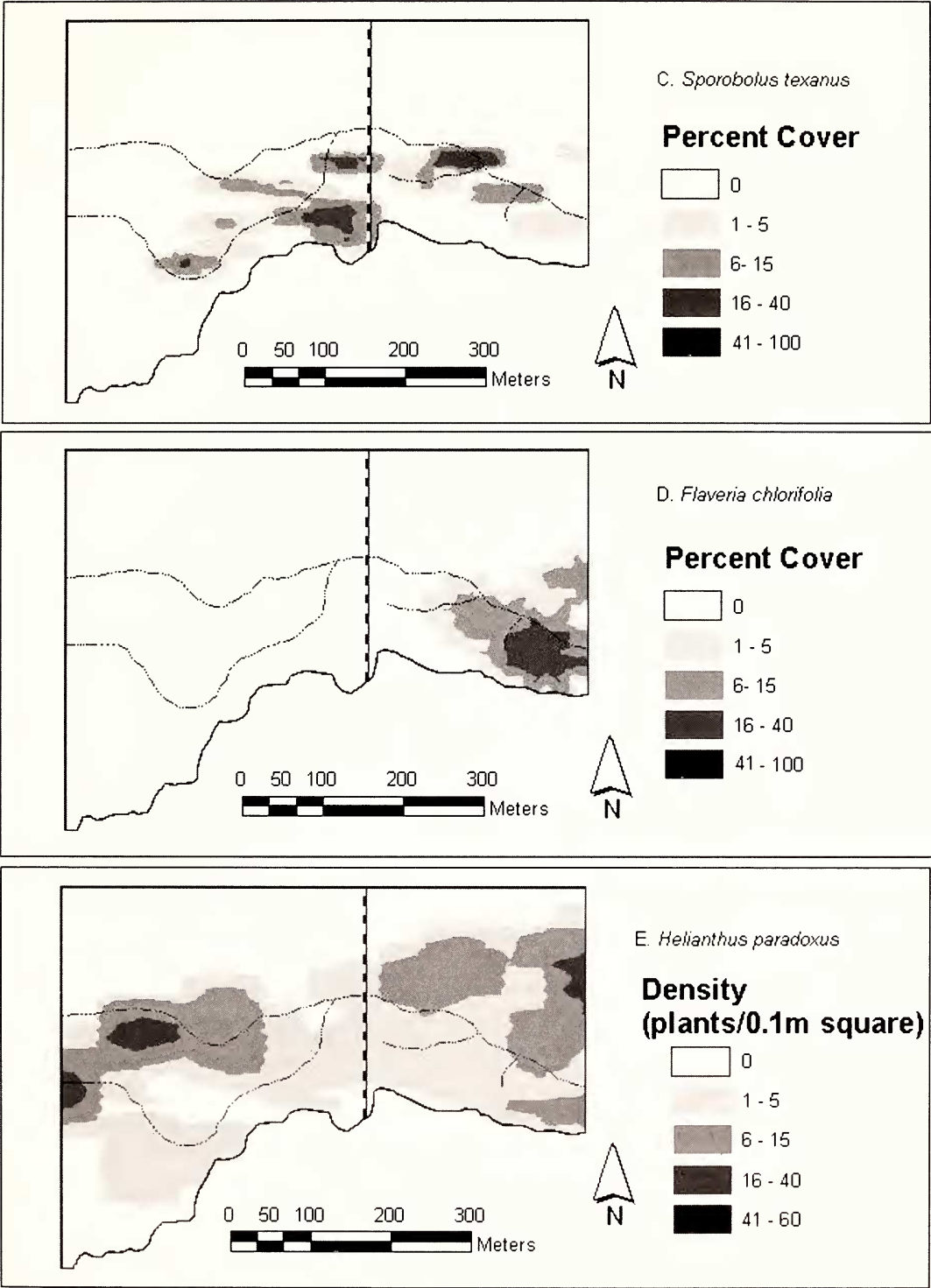


FIG. 4. Continued.

TABLE 2. TOTAL AREA (HA) FOR EACH OF THE FIVE SPECIES WITH OVERALL COVER VALUES OF 1–9% IN THE SALT MARSH OF THE DIAMOND Y SPRING PRESERVE NEAR FORT STOCKTON, TEXAS. Area (ha) is displayed for each of the classes shown in Figure 4. In parenthesis is the percentage of the total marsh area. An * in a column indicates an area <0.1 ha. A zero in a column indicates that species was not found in that class.

Species	Total	Class			
		1–5	6–15	16–40	41–100
<i>Limonium limbatum</i>	5.8 (26.9)	5.3 (24.5)	0.5 (2.4)	0	0
<i>Suaeda calceoliformis</i>	15 (69.4)	6.3 (29.2)	4.9 (22.7)	3.7 (17.1)	0.1 (0.4)
<i>Sporobolus texanus</i>	3 (13.9)	1.4 (6.5)	1.3 (6.0)	0.3 (1.4)	—*
<i>Flaveria chlorifolia</i>	2.5 (11.6)	0.9 (4.2)	1.1 (5.1)	0.5 (2.3)	—*
<i>Helianthus paradoxus</i>	13 (60.2)	7.9 (36.6)	4.5 (20.8)	0.6 (2.8)	0

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